What is claimed is:

1. A method to measure the complex frequency-dependent dilatational and shear wavenumbers of a material under a static compressional force comprising the steps of:

subjecting the material to a compressional load;

vibrating the material in a vertical direction at a range of test frequencies;

measuring a first set of material motion parameters for each frequency in the range while the material is vibrating in the vertical direction;

vibrating the material in a horizontal direction at the range of test frequencies;

measuring a second set of motion parameters for each frequency in the range while the material is vibrating in the horizontal direction;

obtaining a dilatational wavenumber by utilizing said measurement of motion parameters obtained while said material was vibrating in the vertical direction;

obtaining a shear wavenumber by utilizing said measurement of motion parameters obtained while said material was vibrating in the horizontal direction; and

calculating material parameters from known material properties and a selected one of the shear wavenumber, dilatational wavenumber, and both wavenumbers at each test frequency.

2. The method of claim 1 wherein the steps of measuring a first set of motion parameters comprises mounting accelerometers on the material to measure the acceleration of the material away from the source of the vibration, the acceleration of the material being one motion parameter.

3. The method of claim 2 wherein the steps of measuring a second set of motion parameters comprises mounting accelerometers on the material to measure the acceleration of the material away from the source of the vibration, the acceleration of the material being one motion parameter.

4. The method of claim 1 wherein the steps of measuring a first set of motion parameters comprises mounting velocimeters on the material to measure the velocity of the material away from the source of the vibration, the velocity of the material being one motion parameter.

5. The method of claim 4 wherein the steps of measuring a second set of motion parameters comprises mounting velocimeters on the material to measure the velocity of the material away from the source of the vibration, the velocity of the material being one motion parameter.

6. The method of claim 1 wherein the step of calculating material parameters includes at least one parameter selected from complex dilatational wavespeed, complex shear wavespeed, complex Lamé constants, complex Young's modulus, complex shear modulus, and complex Poisson's ratio.

7. The method of claim 1 wherein said step of obtaining a dilatational wavenumber comprises:

plotting an absolute value of the difference between a predicted dilatational wavenumber and the first set of motion parameters on a real dilatational wavenumber versus imaginary dilatational wavenumber graph for each frequency starting at the lowest frequency of the range of test frequencies;

finding the values of the real dilatational wavenumber and imaginary dilatational wavenumber at each frequency that will result in a minimum for the difference

between a predicted wavenumber and the first set of motion parameters; and

identifying actual minima from the found values, said actual minima giving the complex dilatational wavenumber.

8. The method of claim 7 wherein the step of identifying actual minima comprises:

identifying the found value at the lowest frequency as an actual minimum;

changing the frequency to a higher frequency of said range of test frequencies; and

identifying the found value closest to the previous actual minimum having a real dilatational wavenumber higher than that of the previous actual minimum as the actual minimum at that frequency.

9. The method of claim 1 wherein said step of obtaining a shear wavenumber comprises:

plotting an absolute value of the difference between a predicted shear wavenumber and the second set of motion parameters on a real shear wavenumber versus imaginary

shear wavenumber graph for each frequency starting at the lowest frequency of the range of test frequencies;

finding the values of the real shear wavenumber and imaginary shear wavenumber at each frequency that will result in a minimum for the difference between a predicted wavenumber and the second set of motion parameters; and

identifying actual minima from the found values, said actual minima giving the complex shear wavenumber.

10. The method of claim 9 wherein the step of identifying actual minima comprises:

identifying the found value at the lowest frequency as an actual minimum;

changing the frequency to a higher frequency of said range of test frequencies; and

identifying the found value closest to the previous actual minimum having a real shear wavenumber higher than that of the previous actual minimum as the actual minimum at that frequency.

11. The method of claim 1 wherein said step of calculating material parameters comprises:

finding a complex dilatational wavespeed from the complex dilatational wavenumber;

finding a complex shear wavespeed from the complex shear wavenumber;

calculating Lamé constants from the complex shear wavespeed, complex dilatational wavespeed and the known material property of density; and

calculating at least one of a complex Poisson's ratio and a complex Young's modulus from said calculated Lamé constants.